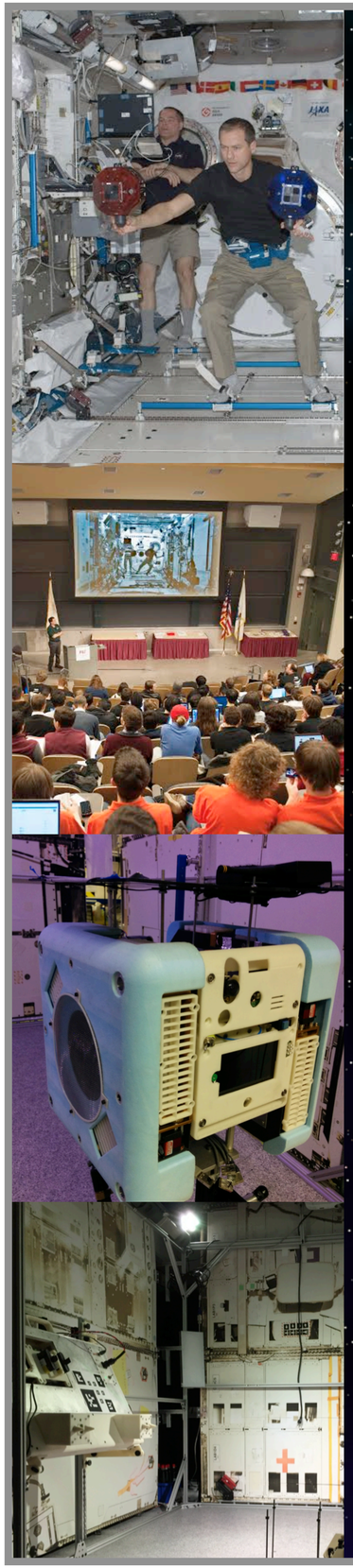
ISS Robotic Student Programming



What are SPHERES, Zero Robotics and Astrobee?

The **SPHERES** facility is a set of three free-flying satellites launched in 2006. In addition to scientists and engineers, middle- and high-school students program the SPHERES during the annual Zero Robotics programming competition.

Zero Robotics conducts virtual competitions via simulator and on SPHERES aboard the ISS, with students doing the programming. A web interface allows teams to submit code, receive results, collaborate, and compete in simulator- based initial rounds and semi-final rounds. The final round of each competition is conducted with SPHERES aboard the ISS.

At the end of 2017 a new robotic platform called **Astrobee** will launch, providing new game elements and new ground support for even more student interaction.

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New Game Elements

Astrobee will allow Zero Robotics to go beyond virtual game elements and have students interact with real objects on board the ISS, including manipulation, viewing and sensing.

Real world sensing

Astrobee will be uniquely capable of sensing the world around it. Students will program the robots to identify objects and look for physical games elements using cameras and an RFID sensor.

Real world manipulation

Astrobee will also be uniquely capable of manipulating the world around it. A pan/tilt arm and gripper will allow Zero Robotics competitions to include grasping handrails, grappling other Astrobee units, and gripping real-world objects created for each game. Students will learn how to issue commands and how to coordinate motion of the vehicle with motion of the arm and gripper.

New Ground Elements

Hands-on hardware

Because Astrobee is based on inexpensive cellphone technology, we plan to provide teams with a hardware development kit to allow students *hands-on learning*. Students will be able to see the results of code with their own eyes and experiment with the hardware.

See a robot

An in-school robotic platform is planned to allow demonstration and testing in a classroom or gym, allowing students to demonstrate their code and robot behavior. These demonstrations will help to foster interest in other students who are not directly involved in the competition, and may lead to smaller school-level competitions.

Ground testing

Astrobee will offer the ability to run competitions in a terrestrial lab, giving students the ability to test on the ground before testing in space, and see how results can differ. The ground lab is being outfitted with visual representations of ISS lab walls, and lights and handrails for the vehicle to use for navigation and as part of the competitions.